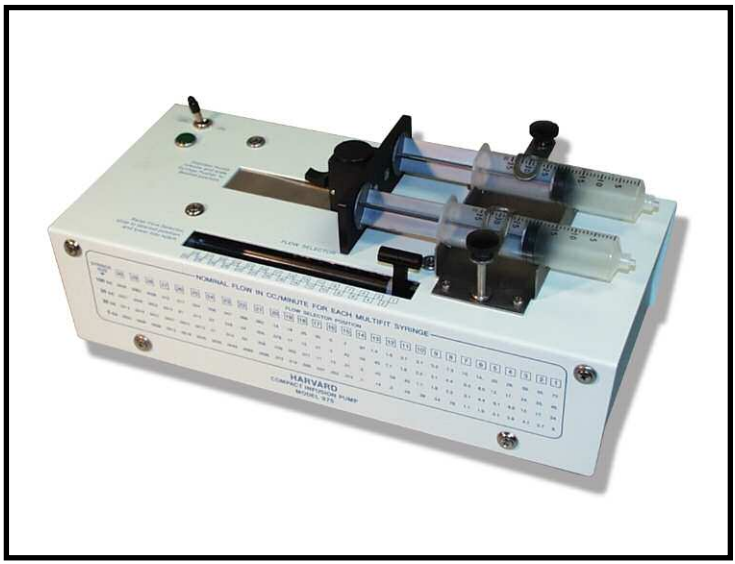
Model '975' / '2274'

Syringe Pump Series

User's Manual

Model '975' Syringe Pump	*MA1 55-1689*
Model '2274' Syringe Pump	*MA1 55-3206*



HARVARD
APPARATUS

WEEE/RoHS Compliance Statement

EU Directives WEEE and RoHS

To Our Valued Customers:

We are committed to being a good corporate citizen. As part of that commitment, we strive to maintain an environmentally conscious manufacturing operation. The European Union (EU) has enacted two Directives, the first on product recycling (Waste Electrical and Electronic Equipment, WEEE) and the second limiting the use of certain substances (Restriction on the use of Hazardous Substances, RoHS). Over time, these Directives will be implemented in the national laws of each EU Member State.

Once the final national regulations have been put into place, recycling will be offered for our products which are within the scope of the WEEE Directive. Products falling under the scope of the WEEE Directive available for sale after August 13, 2005 will be identified with a "wheelie bin" symbol.

Two Categories of products covered by the WEEE Directive are currently exempt from the RoHS Directive – Category 8, medical devices (with the exception of implanted or infected products) and Category 9, monitoring and control instruments. Most of our products fall into either Category 8 or 9 and are currently exempt from the RoHS Directive. We will continue to monitor the application of the RoHS Directive to its products and will comply with any changes as they apply.

- **Do Not Dispose Product with Municipal Waste**
- **Special Collection/Disposal Required**

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Serial Numbers

All inquires concerning our product should refer to the serial number of the unit. Serial numbers are located on the rear of the chassis.

Calibrations

All electrical apparatus is calibrated at rated voltage and frequency. While the flow will stay calibrated, the peak will vary.

Warranty

Harvard Apparatus warranties this instrument for a period of two years from date of purchase. At its option, Harvard Apparatus will repair or replace the unit if it is found to be defective as to workmanship or material.

This warranty does not extend to damage resulting from misuse, neglect or abuse, normal wear and tear, or accident. This warranty extends only to the original customer purchaser.

IN NO EVENT SHALL HARVARD APPARATUS BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. Some states do not allow exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you. **THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR USE, OR OF ANY OTHER NATURE.** Some states do not allow this limitation on an implied warranty, so the above limitation may not apply to you.

If a defect arises within the two-year warranty period, promptly contact ***Harvard Apparatus, Inc., 84 October Hill Road, Building 7, Holliston, Massachusetts 01746-1371*** using our toll free number ***1-800-272-2775***. Goods will not be accepted for return unless an RMA (returned materials authorization) number has been issued by our customer service department. The customer is responsible for shipping charges. Please allow a reasonable period of time for completion of repairs, replacement and return. If the unit is replaced, the replacement unit is covered only for the remainder of the original warranty period dating from the purchase of the original device.

This warranty gives you specific rights, and you may also have other rights which vary from state to state.

Repair Facilities and Parts

Harvard Apparatus stocks replacement and repair parts. When ordering, please describe parts as completely as possible, preferably using our part numbers. If practical, enclose a sample or drawing. We offer a complete reconditioning service.

CAUTION

This pump is not registered with the FDA and is not for clinical use on human patients.

Specifications

This is the pump that made Harvard's reputation for reliability and precision. The DC motor and gear box provide low flow rates and a complete absence of pulsation. Its synchronous motor is regulated by the supply line frequency giving the ultimate accuracy, +/- 0.01%. Its thirty speed mechanical gear box is an engineering marvel that will give years of service.

The pump has speed accuracy of ±0.01% and a 30-speed mechanical gear box with positive locking action. The ratio between adjacent settings has been held to only 1.4 to 1. The range over the 30-gear settings is 17,000 to 1. A gear overload clutch stops pumping at a back pressure of about 25 p.s.i.

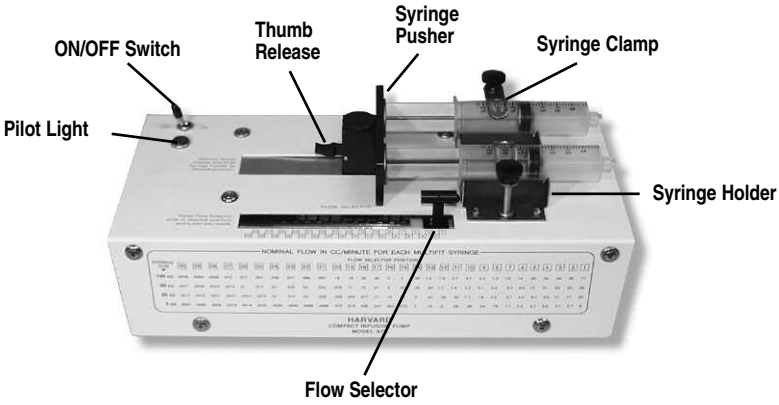
This Pump's syringe holder can hold either one or two plastic or glass syringes of any size from 2 ml to 100 ml. Two additional syringe holders are supplied and can be easily installed. The first will hold up to three 20 ml syringes and the second up to four 5 ml syringes.

Specifications

Pump '975'	
Type	Mechanical multiple-syringe; infusion only
Motor	30 speed
Syringe/Size:	Glass and Plastic
Holder for up to 2 Syringes	2 ml to 100 ml (Adjustable)
Holder for up to 3 Syringes	20 ml (Only)
Holder for up to 4 Syringes	5 ml (Only)
Dimensions, H x W x D	335 x 171 x 89 mm (14 x 6 3/4 x 3 1/2 in)
Weight	5.4 hg (12 lb)
Pump '2274'	
Type	Mechanical multiple-syringe; infusion only
Motor	30 speed (100 times slower than pump '975')
Syringe/Size:	Glass and Plastic
Holder for up to 2 Syringes	10 ml to 100 ml (Adjustable)
Holder for up to 3 Syringes	20 ml (Only)
Holder for up to 4 Syringes	5 ml (Only)
Dimensions, H x W x D	335 x 171 x 89 mm (14 x 6 3/4 x 3 1/2 in)
Weight	5.4 hg (12 lb)

Catalog No.	Description
55-1689	975, 115 VAC, 60 Hz
55-1697	975A, 230 VAC, 50 Hz
55-1705	975B, 115 VAC, 50 Hz
55-3206	2274, 115 VAC, 60 Hz
55-3214	2274A, 230 VAC, 50 Hz

Pump Layout



Getting Acquainted With Your Compact Syringe Pump

Before using the Compact Syringe Pump, we suggest you run through the following familiarization procedure.

Step 1

Set the Compact Syringe Pump on a table with the Flow Chart facing you. Plug the cord into an electrical outlet and snap the ON/OFF switch to ON. Listen to the sound of the pump running. Note that the Pilot Light is on.

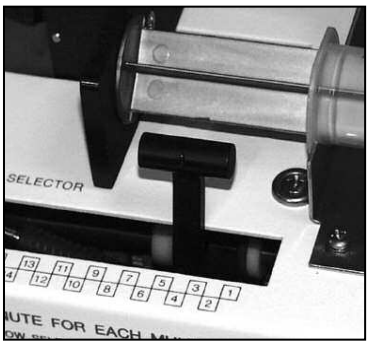
Caution: This pump must always be use with a 3-wire, grounded electrical outlet. If your location has only 2-wire receptacles, consult you electrician for proper grounding procedures.

Step 2

Push the Flow Selector away from you and slide it laterally back and forth. Release the Flow Selector and feel it drop into one of the 30 numbered slots. The slot you choose determines the speed that the Syringe Pusher advances the syringe plunger.

Note that when you choose any of the odd-numbered slots (such as #1, the fastest speed), the Flow Selector drops only about half way down.

When you choose any of the even-numbered slots (such as #2) the Flow Selector drops all the way down. The position of each number on the scale shows you whether that slot position is halfway down or all the way down.

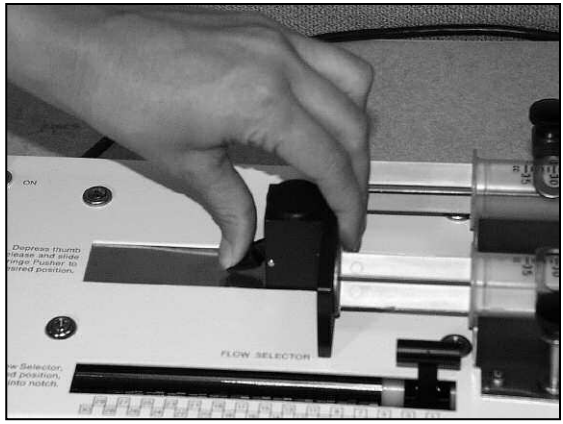


Lever Up

Lever Down

Step 3

Grasp the Syringe Plunger, push down on the Thumb Release and slide the Syringe Pusher back and forth. Note that when you let go of the Thumb Release, the Syringe Pusher stays in place.

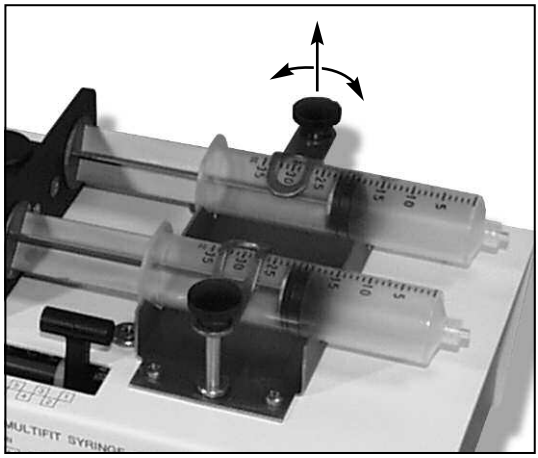


Step 4

Turn the pump on. Position the Syringe Pusher to the right as far as it will go. This is its position after the pump has emptied a syringe. Position the Flow Selector in slot number 1 — the fastest pumping speed. Listen to the pump. Immediately you will hear a rapid "clicking". This is perfectly normal and occurs whenever the Syringe Pusher movement is obstructed. At slower pumping speeds, the clicks occur less frequently. At the slowest speed — Flow Selector position number 30 — a single "click" occurs only once every hour or so.

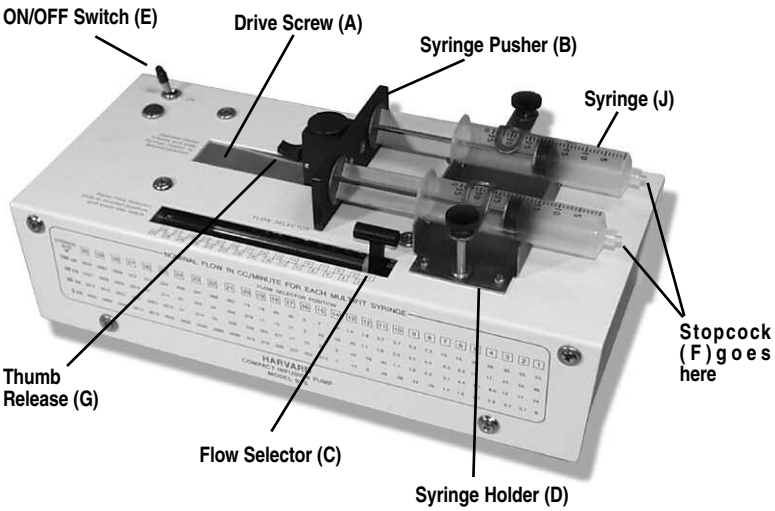
Step 5

The Compact Syringe Pump has a place for two syringes. The picture below shows how a syringe fits in the two "vee" notches and how it is held in place by a Syringe Clamp. The syringe barrel flange should be snug against the Syringe Holder as illustrated so that the barrel cannot move forward during pumping action. Lift one of the syringe clamps and feel the spring pressure. Turn it and observe how easily you can position it so that it holds the syringe in place.



Description

The Compact Syringe Pump is designed for infusion (emptying syringes) only, using glass, disposable plastic, stainless steel or glass "O" Ring Robb syringes from 100 to 1 cc.



The pump consists of a synchronous motor of 100 R.P.M., a 30 step parallel shaft gear box, clutch, drive screw and syringe holder. As illustrated the syringe (J) is drive by a drive screw (A), which moves a spring loaded half-nut connected to the pusher plate (B).

The 30 position gear box permits the instantaneous selection of any speed of over 17,000 to 1 range. The ratio between adjacent rates is 1.4 to 1. The close coupled gear box permits exact changes in flow rate, all at synchronous speeds. Between the 30 speeds and the use of one or two syringes, a total of 2400 infusion rates are possible. The maximum rate using two 100 ml syringes is 154.8 ml per minute, while the slowest rate using one 1 cc tuberculin syringe is .000077 cc per minute.

Syringe Clamps

Standard syringes are held in a universal syringe holder plate as explained in Step 5. The syringe pusher (B) can then be adjusted against the extended plunger of the syringe by pushing down on the thumb release lever (G) and sliding the syringe pusher. When the syringes have emptied, the built in overload clutch will begin to click. The pump will not automatically turn itself off. The clutch mechanism will disengage and make a clicking sound with each revolution of the drive screw. Binding in the syringes or clogging of the media will also cause the clutch to disengage pumping action.

For convenience in carrying out repetitive infusion procedures, it is possible to refill the syringes without their removal from the pump by use of a three way stopcock (F) connected to the media reservoir.

Syringe

The pump has been calibrated on the basis of Becton-Dickinson multifit glass syringes, although it will handle other types. Plastic disposable syringes are excellent for procedures requiring minimum leakage. Check actual delivery rates when using any other brand or type of syringe. In general, it has been found that when the media is viscous, highly volatile, or quick drying, a plastic "O" ring syringe is preferrerd.

Binding of glass syringes may sometimes occur when the syringe plunger is extended to its maximum. Satisfactory results can be obtained by using a larger capacity syringe at less than maximum volume.

A wide variety of plastic, glass and stainless steel syringes as well as stopcocks and Luer adapters are available from Harvard Apparatus. Consult our Harvard Bioscience Full Line Catalog.

Flow Rate: 975

The flow rate table on the pump shows the flow rate per syringe expressed in cc/minute. The gear box provides 30 positions, each numbered. To shift gears, push the flow selector (C, refer to figure, page 4) toward the syringe plate and slide it to the desired position. See step 2. Until you become accustomed to handling the flow selector, accuracy can be assured by checking the high and low flow selector positions notches by looking through the slot. It is not necessary to turn off the pump when shifting from one flow rate to another.

Because of the involvement of many gears, the pump may require one or two minutes of build up time for procedures carried out at lower speeds. It is advisable to turn the pump on and allow it to run at the desired flow rate setting while syringes are being filled and placed in the syringe holder (D). A lead time of a couple of minutes may be necessary when the gear position is between 15 and 30. At higher pumping rates (below 15) pumping action will be virtually instantaneous.

Flow Rates for Non-Standard Syringes

To find the correct Flow Selector setting for a desired flow rate when using a syringe other than one of the four standard B-D size calibrated on the side of the Compact Syringe Pump, carefully measure the diameter of the syringe plunger and refer to the next two pages.

Harvard Classical Mechanical '975' Syringe Pump

Nominal Flow Rate (ml/min)

Gear Position	Syringe Size 5 ml	20 ml	50 ml	100 ml
1	8.04	23.6	46.3	77.4
2	5.74	16.9	33.1	55.3
3	4.10	12.1	23.6	39.0
4	2.93	8.61	16.9	28.0
5	2.09	6.15	12.1	20.2
6	1.49	4.39	8.64	14.4
7	1.07	3.14	6.17	10.3
8	0.763	2.24	4.41	7.34
9	0.545	1.60	3.15	5.25
10	0.389	1.14	2.25	3.75
11	0.278	0.816	1.61	2.68
12	0.198	0.583	1.15	1.91
13	0.142	0.416	0.821	1.36
14	0.101	0.297	0.586	0.975
15	0.0724	0.212	0.419	0.696
16	0.0517	0.152	0.299	0.497
17	0.0369	0.108	0.214	0.355
18	0.0264	0.0774	0.153	0.254
19	0.0188	0.0553	0.109	0.181
20	0.0135	0.0395	0.0779	0.129
21	0.00961	0.0282	0.0556	0.0925
22	0.00687	0.0201	0.0397	0.0661
23	0.00490	0.0144	0.0284	0.0472
24	0.00350	0.0103	0.0203	0.0337
25	0.00250	0.00734	0.0145	0.0241
26	0.00179	0.00525	0.0104	0.0172
27	0.00128	0.00375	0.00743	0.0123
28	0.000912	0.00268	0.00531	0.00877
29	0.000651	0.00191	0.00379	0.00626
30	0.000465	0.00136	0.00271	0.00447

Flow Rate: Non-Standard Syringes

Flow Selector Position - '975'	Diameter of Plunger (Flow Rates: cc/min.)								
	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
1	.59	1.35	2.39	3.75	5.41	7.35	9.57	12.1	15.0
2	.421	.964	1.71	2.68	3.86	5.25	6.83	8.64	10.7
3	.301	.688	1.22	1.91	2.78	3.75	4.88	6.17	7.64
4	.215	.491	.871	1.36	1.97	2.68	3.49	4.41	5.46
5	.154	.351	.622	971	1.41	1.91	2.49	3.15	3.90
6	.110	.251	.444	.693	.101	1.36	1.78	2.25	2.79
7	.0786	.179	.317	.495	.721	.971	1.27	1.61	1.99
8	.0561	.128	.226	.354	.515	.693	.907	1.15	1.42
9	.0401	.0914	.161	.253	.368	.495	.648	.714	1.01
10	.0286	.0653	.115	.181	.263	.354	.463	.510	.721
11	.0204	.0466	.0821	.129	.188	.253	.331	.364	.515
12	.0146	.0333	.0586	.0921	.134	.181	.236	.260	.368
13	.0104	.0238	.0419	.0658	.0957	.129	.169	.186	.263
14	.00743	.0170	.0299	.0470	.0683	.0927	.121	.133	.188
15	.00531	.0121	.0214	.0336	.0488	.0658	.0864	.0950	.134
16	.00379	.00864	.0153	.0240	.0349	.0470	.0617	.0678	.0957
17	.00271	.00617	.0109	.0171	.0249	.0336	.0441	.0484	.0683
18	.00195	.00441	.00778	.0122	.0178	.0240	.0315	.0346	.0488
19	.00139	.00315	.00556	.00871	.0127	.0171	.0225	.0247	.0349
20	.000993	.00225	.00397	.00622	.00907	.0122	.0161	.0176	.0249
21	.000709	.00161	.00284	.00444	.00648	.00871	.0115	.0126	.0178
22	.000506	.00115	.00203	.00317	.00463	.00622	.00821	.00900	.0127
23	.000361	.000821	.00145	.00226	.00331	.00444	.00586	.00643	.00907
24	.000258	.000586	.00104	.00161	.00236	.00317	.00419	.00459	.00648
25	.000184	.000419	.000742	.00115	.00169	.00226	.00299	.00328	.00463
26	.000131	.000299	.000530	.000821	.00121	.00161	.00214	.00234	.00331
27	.0000936	.000214	.000379	.000586	.000864	.00115	.00153	.00167	.00236
28	.0000668	.000153	.000271	.000419	.000617	.000821	.00109	.00119	.00169
29	.0000477	.000109	.000194	.000299	.000441	.000586	.000778	.000850	.00121
30	.0000341	.0000778	.000139	.000214	.000315	.000419	.000556	.000607	.000864

Flow Rate: Non-Standard Syringes

Flow Selector Position - '975'										
	Diameter of Plunger (Flow Rates: cc/min.)									
	11/16	3/4	13/16	7/8	15/16	1	11/16	1-1/8	1-13/16	1-1/4
1	18.1	21.6	25.3	29.4	33.7	38.3	43.2	48.4	54.0	59.7
2	12.9	15.4	18.1	21.0	24.1	27.4	30.9	34.6	38.6	42.6
3	9.21	11.0	12.9	15.0	17.2	19.6	22.1	24.7	27.6	30.4
4	6.58	7.86	9.21	10.7	12.3	14.0	15.8	17.6	19.7	21.7
5	4.70	5.61	6.58	7.64	8.78	10.0	11.3	12.6	14.1	15.5
6	3.36	4.01	4.70	5.46	6.27	7.14	8.07	9.00	10.1	11.1
7	2.39	2.86	3.36	3.90	4.48	5.10	5.76	6.43	7.21	7.93
8	1.71	2.04	2.40	2.79	3.20	3.64	4.11	4.59	5.15	5.66
9	1.22	1.46	1.71	1.99	2.29	2.60	2.94	3.28	3.68	4.04
10	.871	1.04	1.22	1.42	1.64	1.86	2.10	2.34	2.63	2.89
11	.622	.743	.871	1.01	1.17	1.33	1.50	1.67	1.88	2.06
12	.444	.531	.622	.721	.836	.950	1.07	1.19	1.34	1.47
13	.317	.379	.444	.515	.597	.678	.764	.850	.957	1.05
14	.226	.271	.317	.368	.426	.484	.546	.607	.683	.750
15	.161	.194	.226	.263	.304	.346	.390	.434	.488	.536
16	.115	.139	.161	.188	.217	.247	.279	.310	.349	.383
17	.0821	.0993	.115	.134	.155	.176	.199	.221	.249	.274
18	.0586	.0709	.0821	.0957	.111	.126	.142	.158	.178	.196
19	.0419	.0506	.0586	.0683	.0793	.0900	.101	.113	.127	.140
20	.0299	.0361	.0419	.0488	.0566	.0643	.0721	.0807	.0907	.100
21	.0214	.0258	.0299	.0349	.0404	.0459	.0515	.0576	.0648	.0714
22	.0153	.0184	.0214	.0249	.0289	.0328	.0368	.0411	.0463	.0510
23	.0109	.0131	.0153	.0178	.0206	.0234	.0263	.0294	.0331	.0364
24	.00778	.00935	.0109	.0127	.0147	.0167	.0188	.0210	.0236	.0260
25	.00556	.00668	.00778	.00907	.0105	.0119	.0134	.0150	.0169	.0186
26	.00397	.00477	.00556	.00648	.00750	.00850	.00957	.0107	.0121	.0133
27	.00284	.00341	.00397	.00463	.00536	.00607	.00683	.00764	.00864	.00950
28	.00203	.00244	.00284	.00331	.00383	.00434	.00488	.00546	.00617	.00678
29	.00145	.00174	.00203	.00236	.00274	.00310	.00349	.00390	.00441	.00484
30	.00104	.00124	.00145	.00169	.00196	.00221	.00249	.00279	.00315	.00346

Should a significant amount of fluid be spilled into the mechanism, return pump to factory for servicing.

The Compact Syringe Pump has its own electric fuse located near the entrance of the power cord. With the power ON, if the pump motor does not run and the pilot light does not light, examine the fuse. If blown, replace it. If it blows again, return the unit to Harvard Apparatus for servicing.

Power Consumption:	60 Watts max.
Fuse:	1/4 Amp Slo-Blo (all models)

Flow Rate: 2274

2274 Microliter Rates

To find the correct Flow Selector setting for a desired flow rate when using a syringe between 500µl to 50 ml. See Example to right:

2274 Backlash

The Model 2274 pump contains many gears which reduce the speed of the drivetrain to extremely slow speeds. There is a finite time for gears to "catch-up" (backlash). For best operation, particularly at low speeds, the pump should be turned on and the proper gear position selected well before the onset of pumping. 30-60 minutes is not unusual at slow rates. Backlash increases with the higher gear position numbers.

The only area requiring attention is the drive screw. This should be oiled (one or two drops of light oil) approximately twice a year.

Harvard Classical Mechanical '2274' Syringe Pump

Nominal Flow Rate (ml/min)

Gear Position	Syringe Size	Flow Rate
13	500 µl	.111
15	1.0 ml	.114
18	2.5 ml	.103
20	5 ml	.105
22	10 ml	.108
24	20 ml	.0993
25	30 ml	.0949
26	50 ml	.104

Flow Rate: 2274 (Contd)

Flow Rates (µl/min) for Harvard Classic Mechanical '2274' Syringe Pump Gear Syringe Size (Harvard Gas-Tight Microliter/Hamilton Series 1000)								
Position	10 µl	25 µl	50 µl	100 µl	250 µl	500 µl	1 ml	2.5 ml
1	0.126	0.315	0.630	1.26	3.15	6.30	12.6	31.5
2	0.0900	0.225	0.450	0.900	2.25	4.50	9.00	22.5
3	0.0643	0.161	0.321	0.643	1.61	3.21	6.43	16.1
4	0.0459	0.115	0.229	0.459	1.15	2.29	4.59	11.5
5	0.0328	0.0820	0.164	0.328	0.820	1.64	3.28	8.20
6	0.0234	0.0586	0.117	0.234	0.586	1.17	2.34	5.86
7	0.0167	0.0418	0.0835	0.167	0.418	0.835	1.67	4.18
8	0.0119	0.0299	0.0597	0.119	0.299	0.597	1.19	2.99
9	0.00854	0.0213	0.0426	0.0854	0.213	0.426	0.854	2.13
10	0.00610	0.0152	0.0304	0.0610	0.152	0.304	0.610	1.52
11	0.00436	0.0109	0.0217	0.0436	0.109	0.217	0.436	1.09
12	0.00311	0.00778	0.0155	0.0311	0.0778	0.155	0.311	0.778
13	0.00222	0.00556	0.0111	0.0222	0.0556	0.111	0.222	0.556
14	0.00159	0.00397	0.00792	0.0159	0.0397	0.0792	0.159	0.397
15	0.00114	0.00283	0.00566	0.0111	0.0283	0.0566	0.114	0.283
16	0.000811	0.00202	0.00404	0.00811	0.0202	0.0404	0.0811	0.202
17	0.000580	0.00145	0.00289	0.00580	0.0145	0.0289	0.0580	0.145
18	0.000414	0.00103	0.00206	0.00414	0.0103	0.0206	0.0414	0.103
19	0.000300	0.000738	0.00147	0.00300	0.00738	0.0147	0.0300	0.0738
20	0.000211	0.000527	0.00105	0.00211	0.00527	0.0105	0.0211	0.0527
21	0.000151	0.000376	0.000752	0.00151	0.00376	0.00752	0.0151	0.0376
22	0.000108	0.000269	0.000537	0.00108	0.00269	0.00537	0.0108	0.0269
23	0.0000769	0.000192	0.000384	0.000769	0.00192	0.00384	0.00769	0.0192
24	0.0000550	0.000137	0.000274	0.000550	0.00137	0.00274	0.00550	0.0137
25	0.0000393	0.0000930	0.000196	0.000393	0.000980	0.00176	0.00393	0.00980
26	0.0000281	0.0000700	0.000140	0.000281	0.000700	0.00140	0.00281	0.00700
27	0.0000200	0.0000500	0.0000998	0.000200	0.000500	0.000998	0.00200	0.00500
28	0.0000143	0.0000357	0.0000713	0.000143	0.000357	0.000713	0.00143	0.00357
29	0.0000102	0.0000255	0.0000509	0.000102	0.000255	0.000509	0.00102	0.0025
30	0.00000073	0.0000182	0.0000364	0.000073	0.000182	0.000364	0.00073	0.000182